

TITLE OF THE INVENTION

IMAGE PROCESSING APPARATUS AND IMAGE PROCESSING METHOD

5

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to an image processing method and apparatus having a plurality of image processing sections for performing predetermined image processing on input image data and for outputting the image data.

Description of the Related Art

Digital multifunction machines (multifunction peripherals, hereinafter referred to as "MFPs") combining the functions of a copier, a fax, a printer, etc., are widely used. In the MFPs, input/output operations by a scanner section, a printer section, etc., the operation of a function for connecting to a network and a communication line, and the function of image processing of image data, as well as operations in which those are combined, are controlled by a control section (CPU) for controlling the entire system.

An MFP typically comprises an image processing section having several image processing (IP) functions for performing various image processing, such as, for example,

resolution conversion, binarization, rotation processing,
and color conversion, on input image data. For example, in
a copier disclosed in Laid-Open Japanese Patent No. 4-1771,
an image processing section is disclosed in which each of
5 these functions is realized as an image processing circuit,
and each circuit is connected in series so as to perform
pipeline processing on the image data. The system
controller (CPU) of this copier is capable of performing
settings for image processing in each image processing
10 circuit and performing data transfer instructions thereto
via a bus line, and thus is capable of performing desired
image processing for each area of an image.

Meanwhile, in recent years, MFPs have appeared in which
concurrent multifunction operation is made possible such
15 that, in addition to simply combining a plurality of device
functions so as to operate in sequence, for example, while a
fax operation is being performed, a copying operation can be
performed. By using, as an example, a case where a copying
operation is performed while a fax transmission operation is
20 being performed, a conventional concurrent multifunction
operation is described. Here, it is assumed that an image
processing section of the MFP is constructed so as to
perform pipeline processing by a plurality of image
processing circuits, as described in the conventional art.
25 It is also assumed that image data for the fax operation and

image data for the copying operation, input by a scanner section, are temporarily stored in a memory in page units.

First, the MFP starts image processing on image data for fax transmission. The CPU performs image processing settings for fax transmission in each image processing circuit within the image processing section via a bus line, etc. Examples of settings include image processing information (resolution, binarization processing method, angle of rotation, paper size, etc.) in each image processing circuit (circuit having resolution conversion function, binarization function, rotation function, etc.). After setting these pieces of image processing information, image data for fax transmission is transferred from the memory to the image processing section, and image processing is performed in sequence for each area in the image data. Then, when image processing for one page of the image data for fax transmission is completed, image processing is started on the image data for the copying operation. The CPU sets image processing information in the image processing section in order to perform image processing. After the setting, the image data is transferred to the image processing section, and in a similar manner, image processing for one page is performed.

In this manner, conventionally, device function operations of the scanner section, the printer section, and

the fax function section are concurrently performed in parallel. However, the image processing performed by the image processing section is only processing for each device function operation, which is switched in page units and is performed. That is, a concurrent multifunction operation is not performed in the image processing section, and as is conventionally done, the memory is allocated in page units and the image data is processed in page units. Therefore, it cannot be said that the memory is used effectively, and it cannot be said that efficiency is satisfactory from the viewpoint of performing image processing.

Accordingly, an image processing apparatus has been conceived in which image data in page units is divided in advance into areas having a predetermined size before image processing is performed, and processing is performed in units of the divided area image data. For example, since an image processing section having a construction for performing the above-described pipeline processing can perform image processing for each desired area, image processing in units of the divided area image data can be easily performed. As a result of forming the image processing section in this manner, it is possible to use the memory in units of the area image data.

In addition, since image data for a plurality of device function operations is input in units of the area image data,

image processing can be performed in parallel. For example, inside the image processing section, parallel processing can be performed such that while resolution conversion is being performed on the image data related to the fax communication operation, a rotation operation is performed on the image data related to the copying operation.

However, since image data in page units is divided into a plurality of area image data, the number of pieces of image data to be processed becomes enormous. Furthermore, image data for the object of a different image processing operation coexists inside the image processing section. Therefore, in a case where setting for status recognition and image processing of the image processing section, and image data transfer control, using a bus line, etc., which is conventionally performed, are performed, the amount of management information to be processed becomes enormous. As a result, a problem arises in that it is difficult for the CPU which controls the entire system to manage the image processing section.

Furthermore, in a case in which the number of pages to be processed at a time is increased without being limited to performing a concurrent multifunction operation, the number of pieces of area image data, the amount of management information, etc., become enormous. In a similar manner, a problem arises in that it is difficult for the CPU which

controls the entire system to manage the image processing section.

SUMMARY OF THE INVENTION

5

The present invention has been made to solve the above-described problems. An object of the present invention is to provide an image processing apparatus and an image processing method, which are capable of easily managing image processing without imposing a large load on the CPU even in a state in which the number of pieces of image data, the amount of the management information thereof, etc., are large.

10

15

20

25

To achieve the above-mentioned object, according to a first aspect, the present invention provides an image processing apparatus having a plurality of image processing means for performing image processing on input image data and for outputting the image data, the image processing apparatus comprising: creation means for creating packet data by adding a header in which image processing information is described for the image data; and transfer means for transferring the packet data between the creation means and each image processing means, wherein the plurality of image processing means input the packet data from the transfer means, perform image processing on the image data

on the basis of the image processing information described
in the header, create packet data by adding a header in
which the image processing information is rewritten for the
image data after processing, and output the packet data to
5 the transfer means.

Another object of the present invention is to provide
an image processing apparatus and an image processing method,
which are capable of performing image processing for a
plurality of device function operations in a parallel manner
10 without imposing a large load on the CPU even in a state in
which a plurality of device function operations are being
performed.

To achieve the above-mentioned object, according to a
second aspect, the present invention provides an image
15 processing apparatus which has a plurality of image
processing means for performing predetermined image
processing on input image data and for outputting the image
data and which is capable of performing a plurality of
device function operations in parallel using a connected
20 external device, the image processing apparatus comprising:
first creation means for adding a header in which image
processing information corresponding to a first device
function operation is described for image data used in the
first device function operation in order to create first
25 packet data; second creation means for adding a header in

which image processing information corresponding to a second device function operation is described for image data used in the second device function operation in order to create second packet data; and transfer means for transferring the packet data among the first creation means, the second creation means, and each image processing means, wherein the plurality of image processing means comprise first image processing means which inputs the first packet data from the transfer means, which performs image processing on image data on the basis of the image processing information described in the header, which creates packet data by adding a header in which the image processing information is rewritten for the image data after processing, and which outputs the packet data to the transfer means, and second image processing means, while processing related to the first packet data is being performed in the first image processing means, which inputs the second packet data from the transfer means, which performs image processing on image data on the basis of the image processing information described in the header, which creates packet data by adding a header in which the image processing information is rewritten to the image data after processing, and which outputs the packet data to the transfer means.

Yet another object of the present invention is to provide an image processing apparatus and an image

processing method, which are capable of making the input/output interface portions common with other image processing apparatuses in a case in which packet data is used for image processing since a requested process can be specified only by analyzing the information at the beginning of the input data.

To achieve the above-mentioned object, according to a third aspect, the present invention provides an image processing apparatus which is connected to a predetermined data bus and which is capable of transferring packet data to and from an external device via the data bus, the packet data being such that a header in which image processing information is described is added to image data, the image processing apparatus comprising: input means for inputting packet data in such a manner that the data is divided into a header and image data, to which packet data is added to the header in which identification information of a device and processing content information corresponding to the identification information are described in sequence from the beginning of the header in accordance with the sequence of a device which performs processing; header analysis means for analyzing processing content information described at the beginning of the header input by the input means; image processing means for performing image processing on image data input by the input means on the basis of the analysis

result by the header analysis means; header creation means for creating a new header such that the identification information of an external device which next performs image processing and processing content information corresponding to the identification information are located at the beginning of the header; and output means for newly creating packet data from the image data processed by the image processing means and from the header created by the header creation means and for outputting the packet data.

The above and further objects, aspects and novel features of the invention will become more fully apparent from the following detailed description when read in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram illustrating an MFP (Multifunction Peripheral) to which an image processing apparatus of the present invention can be applied;

Fig. 2 is a block diagram illustrating the details of an image processing section 104 shown in Fig. 1;

Fig. 3 illustrates the format of packet data in this embodiment.

Fig. 4 is a flowchart illustrating the procedure of creating packet data 300 shown in Fig. 3;

Fig. 5 is a diagram illustrating a situation in which tiled image data is created for each area from a one-page document 500;

Fig. 6 is a block diagram illustrating the internal construction of the rotation function section 205 of Fig. 2;

Fig. 7 is a flowchart illustrating the operation of the image processing section 104 of Fig. 1;

Fig. 8 is a first illustration of a status change of a header of packet data when processing is performed in accordance with the flowchart shown in Fig. 7;

Fig. 9 is a block diagram illustrating the internal construction of the resolution conversion function section 203 of Fig. 2;

Fig. 10 is a second illustration of a status change of a header of packet data when processing is performed in accordance with the flowchart shown in Fig. 7;

Fig. 11 is a third illustration of a status change of a header of packet data when processing is performed in accordance with the flowchart shown in Fig. 7;

Fig. 12 is a fourth illustration of a status change of a header of packet data when processing is performed in accordance with the flowchart shown in Fig. 7;

Fig. 13 is a flowchart illustrating the operation when tiled image data is transmitted by fax;

Fig. 14 is an illustration of settings of a fax

function;

Fig. 15 is a first illustration of packet data when processing is performed in accordance with the flowchart shown in Fig. 13;

5 Fig. 16 is a second illustration of packet data when processing is performed in accordance with the flowchart shown in Fig. 13; and

Fig. 17 is a third illustration of packet data when processing is performed in accordance with the flowchart shown in Fig. 13.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

15 The embodiments of the present invention will now be described below with reference to the attached drawings.

A block diagram of an MFP (Multifunction Peripheral) to which an image processing apparatus of the present invention can be applied is shown in Fig. 1. It is assumed that the MFP described in this embodiment combines the functions of a fax, a printer, and a copier, and processes color image data.

20 Referring to the block diagram shown in Fig. 1, the entire construction of the MFP in this embodiment will be described first. A CPU 101 controls the entirety of the functions of the MFP, including an image input/output device, 25 such as a scanner section and a printer section, an image

processing section, a communication function section, etc.
Furthermore, the CPU 101 performs a process of creating
packet data (to be described later). A ROM 102 has stored
therein operation programs of the MFP, etc. A RAM 103 is
5 used as a work area for the MFP to operate, and tiled image
data (to be described later) is stored therein. An image
processing section 104 comprises a plurality of IP (Image
Processing) function sections for performing various image
processing, such as color space conversion, resolution
10 conversion, binarization, and rotation, on packet data. An
operation section 105 displays the status and setting
information of the MFP to a user and transfers an operation
command from the user to the CPU 101.

A scanner section 106 is an image reading device for
15 reading an image and generating image data. The scanner
section 106 comprises a lens for collecting light reflected
from a document, a CCD (Charge Coupled Device) sensor for
inputting light and converting it into electrical signals,
an analog signal processing section, and an analog-to-
20 digital conversion circuit (not shown). The scanner section
106 outputs the generated image data to a scanner I/F
(interface) section 107. The scanner I/F section 107
performs various scanner image processing, such as space
filtering processing and input color space conversion, on
25 the image data input from the scanner section 106.

Furthermore, the scanner I/F section 107 divides image data obtained in page units into a plurality of pieces of tiled image data and outputs it to the image processing section 104.

5 A printer I/F section 108 performs printer image processing, such as image area (object) processing, and smoothing, on the image data output from the image processing section 104. It is also possible for the printer I/F section 108 to combine a plurality of pieces of tiled
10 image data with page image data and to output it to a printer section 109. The printer section 109 forms an image on a printing medium on the basis of the image data output from the printer I/F section 108. The printer section 109 is, for example, a printer device, such as a laser beam
15 printer or an LED (Light-Emitting Diode) printer. In the case of a laser beam printer, the printer section 109 is formed of an exposure control section having a semiconductor laser, an image forming section, a transfer control section (not shown) for transfer paper, etc. Instructions of
20 operation to the scanner section 106, the scanner I/F section 107, the printer I/F section 108, and the printer section 109 are performed by the CPU 101 via the image processing section 104.

 A fax function section 110 transmits or receives image
25 data via a communication line on the basis of the

information set in the operation section 105, and performs a predetermined facsimile process. A network section 111 connects various devices, such as a PC (Personal Computer) and other MFPs, on a network via a LAN (Local Area Network), etc.

Next, the details of the image processing section 104 are described with reference to the block diagram shown in Fig. 2. A crossbar switch 201 interconnects each IP function section inside the image processing section 104, the scanner I/F section 107, and the printer I/F section 108 so that free transfer of image data is realized. IP (image processing) function sections 202 to 205 perform respectively different image processing on the image data. It is assumed that the image processing section in this embodiment has four IP function sections described below.

A color-space conversion function section 202 perform, on the input image data, color conversion such that an RGB color space is converted into a CMYK color space which is a second color space. A resolution conversion function section 203 performs resolution conversion on the input image data. In this embodiment, it is assumed that the resolution of the image data read by the scanner section 106 is 600 × 600 dpi. This image data is converted into that at a resolution of, for example, 100 × 200 dpi according to the purpose. A binarization function section 204 performs

binarization on the input image data by an appropriate method selected from a simple binarization, an error diffusion method, etc., according to the type of image data, such as a character or a photograph. A rotation function section 205 performs rotation of, for example, 90°, 180°, or 270°, on the input image data. Although this embodiment was described by these four IP function sections, the image processing section may comprise other IP function sections.

Next, a description is given of packet data used in this embodiment, and a method for creating the packet data. Fig. 3 shows the format of the packet data in this embodiment. Packet data 300 is composed of a header 301 and tiled image data 302. Here, the "tiled image data" is image data formed of a rectangular area having a predetermined number of pixels in the horizontal and vertical directions. The tiled image data 302 is prestored in the RAM 103. In the header 301, image processing information, such as the processing sequence of the IP function sections in a case where image processing for the tiled image data 302 is performed, and processing contents in the respective IP function sections, are described.

Next, the procedure of creating the packet data 300 is briefly described with reference to the flowchart shown in Fig. 4 by taking, as an example, a case in which image data in page units read by the scanner section 106 is stored in

the RAM 103.

Initially, in the operation section 105, a user performs a setting for an image reading process (S401). After the setting, the user issues a reading start command, the CPU 101 receiving this command causes the scanner section 106 to start reading a document (S402). The image data in page units created by the scanner section 106 is input to the scanner I/F section 107, and the scanner I/F section 107 divides the page image data in tile units in accordance with the instructions of the CPU 101 in order to create the tiled image data (S403).

Here, a creation process of step S403 is described in detail. As shown in Fig. 5, a one-page document 500, input as raster image data from the scanner section 106, is divided into a plurality of rectangular areas (tiles). Each rectangular area has a size of 32 pixels vertically and 32 pixels horizontally, and tiled image data is created for each area. Here, if it is assumed that a document of A4 size is read at a resolution of 600 x 600 dpi by the scanner section 106 and is divided by a tile of 32 x 32 pixels, 34,320 pieces of tiled image data is created from the document of A4 size. Furthermore, in the creation of tiled images, the CPU 101 performs a setting for the scanner I/F section 107 according to the reading resolution and the convenience of image processing, making it possible to cause

the tiled image to have a shape and a number of pixels for which handling is easy.

The created tiled image data is input to the image processing section 104 and is transferred to the RAM 103 via the crossbar switch 201. Then, each piece of the tiled image data, together with identification information, etc., is temporarily stored in a predetermined location in the RAM 103 (S404). At this time, a management table of the tiled image data may be created within the RAM 103, and the address at which the management table is stored, identification information, etc., may be collectively managed. The CPU 101 creates a header in accordance with a command related to image processing, set by the operation section 105, or in accordance with information set by a device connected via the network section 111 (S405). The CPU 101 reads the tiled image data corresponding to each header from the RAM 103. Then, the CPU 101 adds the header to the read tiled image data in order to create packet data to be sent to the image processing section 104, and the processing is terminated (S406).

Although in the foregoing, the creation of the packet data in a case where image data is input by the scanner section 106 was described, the image data input destination is not limited thereto, and the image data may be input from the network section 111, the fax function section 110, etc.

In the MFP of this embodiment, the network section 111 and the fax function section 110 can input image data transferred from an external device, etc., and can store the input image data in the RAM 103. In a case where this image data is to be stored as tiled image data in the RAM 103, the CPU 101 may perform a dividing process on the input image data, or the network section 111 and the fax function section 110 may perform a dividing process when image data is input and transfer the created tiled image data to the RAM 103.

Furthermore, the MFP of this embodiment may comprise a storage device (not shown), such as a hard disk drive (HDD), and a disk controller (not shown) for controlling access to the HDD and transfer of image data through a connection between the HDD and the system bus of the MFP. Also in this case, similarly, the CPU 101 may perform a dividing process on the image data transferred from the disk controller, or the disk controller may perform a dividing process on the image data and transfer the created tiled image data to the RAM 103. In a case where image data is input from an external device, a HDD, etc., in this manner, and the tiled image data is stored once in the RAM 103, for the packet data creating process, processing of step S405 and subsequent steps is performed.

Next, the internal construction of the IP function

sections 202 to 205 is described. The IP function sections in this embodiment have the same internal construction. Here, as an example, the internal construction of the rotation function section 205 is described with reference to the block diagram shown in Fig. 6.

An input I/F (interface) section 601 is connected to the crossbar switch 201, so that the input packet data is divided into a header and tiled image data. The header is then sent to a header analysis section 602, and the tiled image data is sent to a rotation processing section 603. The header analysis section 602 extracts image processing information from the header input from the input I/F section 601 and analyzes the information. The header analysis section 602 determines the information at the beginning of the image processing information to be processing content of the rotation processing section 603, and sets the image processing content in the rotation processing section 603. As will be described later, that described as the image processing content in the header is a mode number for identifying which operation mode of the operation modes in which the rotation processing section 603 can perform processing operations should be performed. In the rotation processing section 603, the mode number corresponds to the angle of rotation. Then, the header analysis section 602 transfers the header part after analysis to a header

creation section 604.

The rotation processing section 603 is an IP function section for performing image processing on the image data received from the input I/F section 601 in accordance with the image processing content set by the header analysis section 602. The rotation processing section 603 performs rotation conversion of 0°, 90°, 180°, or 270° on the image data on the basis of, for example, the set processing content (mode), and sends the image data after conversion to a data selection section 605.

The header creation section 604 recreates the header of the packet data which is input to the next image processing section from the header input from the header analysis section 602. The header creation section 604 sends the created header to the data selection section 605. The data selection section 605 selectively outputs the header from the data selection section 605 and the image data output from the rotation processing section 603. The image data output from the data selection section 605 is in the form of packet data. An output I/F section 606, which is connected to the crossbar switch 201, outputs the packet data to the crossbar switch 201.

For the internal construction of the color-space conversion function section 202, the resolution conversion function section 203, and the binarization function section

204, the same description can be made by only replacing the rotation processing section 603, which is an IP function section, with a color-space conversion function section, a resolution conversion function section, and a binarization function section.

Next, a description is given of the operation of the image processing section 104 in a case where image processing is performed on image data, for example, in the sequence shown in the flowchart in Fig. 7 and by the processing content (mode) in this embodiment. Furthermore, the status change of the header of the packet data, caused by this operation, is described with reference to Figs. 8, 10, 11, and 12.

As shown in Fig. 7, it is assumed that an operation is performed for processing the image data prestored in the RAM 103 (S701) in the sequence of mode 2 (S702) of the resolution conversion function section 203 → mode 0 (S703) of the binarization function section 204 → mode 1 (S704) of the rotation function section 205 and for rewriting into the RAM 103 (S705).

First, before entering the operation in each IP function section, the CPU 101 creates packet data from the tiled image data prestored in the RAM 103. The details of a header 800 of the created packet data stored in the RAM 103 are shown in Fig. 8. In the header 800, for the image

processing operation shown in Fig. 7, a set of an ID
indicating which IP function section should be used and the
mode of the image processing indicating what kind of image
processing operation should be performed by that IP function
5 section is described in sequence from the beginning of the
header. Although in this embodiment, only the ID and the
mode are shown, other information, such as data length, may
be added to the header as necessary.

Therefore, when the operation shown in Fig. 7 is to be
10 performed, in a first header part 801, the ID (IP 203) of
the resolution conversion function section 203, which is an
IP function section, which first performs processing, and
the mode (mode 2) of image processing performed by the
resolution conversion function section 203 are described.
15 In a second header part 802, the ID (IP 204) of the
binarization function section 204 which next performs
processing, and the mode (mode 0) of image processing are
described. In a third header part 803, the ID (IP 205) of
the rotation function section 205, and the mode (mode 1) are
20 described. In a fourth header part 804, the ID (RAM 103)
indicating the RAM 103 so that the data is rewritten into
the RAM 103, and information (NC) indicating "no
information" are described.

The CPU 101 transfers the packet data, in which image
25 processing information such as the sequence of image

processing and image processing content indicated by the operation mode are described in the header in this manner, to the resolution conversion function section 203, which is an IP function section which first performs image processing,
5 via the crossbar switch 201.

The internal construction of the resolution conversion function section 203 is shown in the block diagram of Fig. 9. As is clear from the comparison with the rotation function section 205 of Fig. 6, a different component for each IP
10 function section is only a resolution conversion processing section 903 which performs image processing in practice.

In the resolution conversion function section 203 receiving the packet data, an input I/F section 901 divides the packet data into a header and tiled image data, and
15 transfers the header to a header analysis section 902 and transfers the tiled image data to the resolution conversion processing section 903. The header analysis section 902 analyzes the header in order to read the operation mode (mode 2) described in the first header part 801, and sets
20 the operation mode to be performed by the resolution conversion processing section 903 to "2".

The resolution conversion processing section 903 performs image processing of operation mode 2 on the tiled image data received from the input I/F section 901. For
25 example, if the resolution of the input tiled image data is

600 × 600 dpi, and if the operation mode number "2" indicates resolution conversion into 100 × 400 dpi, conversion for reducing an image is performed.

10 A header creation section 904 deletes its own ID and
5 the operation mode from the received header information, and shifts the data within the header information to the left so that the second header part 802 in which the information of the IP function section to be processed next is described is located at the beginning of the header. The newly created header is shown in Fig. 10. The information for the binarization function section at the next IP function section is a first header part 1001, and "no information" (NC) is added to a fourth header part 1002. Then, a data selection section 905 selectively outputs the newly
15 recreated header and the image data after image processing, thereby creating packet data, and the created packet data is sent to an output I/F section 906, and the packet data is sent to the binarization function section 204.

20 The internal construction of the header creation section 904 will now be described in detail below with reference to the block diagram shown in Fig. 11.

Referring to Fig. 11, reference numeral 1100 denotes a bus for inputting header information from the header analysis section 902 to the header creation section 904.
25 Reference numeral 1101 denotes a first memory for storing

the data of a first header part within the input header information. Similarly, reference numeral 1102 denotes a second memory for storing the data of a second header part. Reference numeral 1103 denotes a third memory for storing the data of a third header part. Reference numeral 1104 denotes a fourth memory for storing the data of a fourth header part.

Reference numeral 1105 denotes a bus for transferring the data stored in the second memory 1102 to the first memory 1101. Similarly, reference numeral 1106 denotes a bus for transferring the data stored in the third memory 1103 to the second memory 1102. Reference numeral 1107 denotes a bus for transferring the data stored in the fourth memory 1104 to the third memory 1103.

Reference numeral 1108 denotes an NC creation section for creating "no information" (NC). Reference numeral 1109 denotes a header information recreation section for recreating header information from the data stored in the first memory 1101, the second memory 1102, and the third memory 1103 and from the data created by the NC creation section 1108.

Reference numerals 1110, 1111, 1112, and 1113 denote buses for transferring the data of the first memory 1101, the second memory 1102, the third memory 1103, and the NC creation section 1108 to the header information recreation

section 1109, respectively. Reference numeral 1114 denotes a bus for outputting the header information from the header information recreation section 1109 to a data selection section 905.

5 Reference numeral 1115 denotes a control section for controlling the entire header creation section 904. The control section 1115 controls the first to fourth memories, the NC creation section 1108, the header information recreation section 1109, and the buses by using a signal
10 line (not shown).

 Next, a description is given of the header creation process by the header creation section 904 with reference to the flowchart shown in Fig. 12. The creation process shown in the flowchart of Fig. 12 is controlled by the control
15 section 1115.

 Initially, header information which is input from the header analysis section 902 via the bus 1100 in each memory. Here, if it is assumed that the header information 800 shown in Fig. 8 is input, the first header part 801 is stored in
20 the first memory 1101, the second header part 802 is stored in the second memory 1102, the third header part 803 is stored in the third memory 1103, and the fourth header part 804 is stored in the fourth memory 1104 (step S1201).

 Next, the data of each header part, stored in each
25 memory, is transferred to the memory in which the previous

header part is stored, and is stored therein. That is, the second header part 802 of the second memory 1102 is stored in the first memory 1101, the third header part 803 of the third memory 1103 is stored in the second memory 1102, and
5 the fourth header part 804 of the fourth memory 1104 is stored in the third memory 1103 (step S1202).

Then, the header information recreation section 1109 recreates the header information based on the data transferred from the first to third memories and the NC data created by the NC creation section. The header part is
10 formed in order from the start of the header: the data transferred from the first memory 1101, the data transferred from the second memory 1102, and the data transferred from the third memory 1103. Then, NC data is appended to the end.
15 As a result, header information 1000 shown in Fig. 10 is created (step S1203).

As a result of transferring the header information 1000 created by the header information recreation section 1109 time data selection section 905, a series of header creation
20 processes is terminated (step S1204).

In step S1202, the data of each memory is transferred to the memory in which the previous header part is stored. At this time, the first header part 801 stored in the first memory 1101 has not been transferred anywhere. That is, as
25 a result of the second header part being stored in the first

memory 1101, the first header part 801 is deleted from the header information.

In step S1203, the header information recreation section 1109 creates the header information in order from the start of the header: the first memory 1101, the second memory 1102, the third memory 1103, and the NC creation section 1110. Also, as described above, the data of each header part is transferred among the memories in step S1202. Therefore, in the header information recreation section 1109, the header information is recreated in the form of the header information 1000 in which each header part is shifted toward the start in comparison with the header information 800.

The construction of this header creation section is not possessed only by the resolution conversion function section 203, and the IP function sections 202 to 205 have in common.

After the packet data is output from the resolution conversion function section 203, the above-described operations are repeated by each IP function section. The binarization function section 204 performs image processing in operation mode 0, and the header of the output data becomes as shown in Fig. 13. Furthermore, the rotation function section 205 performs image processing in operation mode 1, and the header information part becomes as shown in Fig. 14. Then, in the packet data output finally from the

rotation function section 205, since the ID of a first header part 1201 is the RAM 103, the data is rewritten into the RAM 103, and the series of operations is terminated.

In this embodiment, the header of the packet data is subjected to image processing in the IP function section, after which the first header part is deleted, and the header part shifts forward in sequence to the previous header part. As a result of shifting in this manner, the header analysis section needs only to analyze only the information at the beginning of the packet data. Therefore, common design of the IP function sections becomes possible for portions other than the components of the rotation processing section 603 and the resolution conversion processing section 903, which perform image processing on the tiled image data.

Next, a description is given of the operation of an MFP in a case where a user issues an operation command to use one device function possessed by the MFP, and image processing related to the device function is performed on the image data according to the operation command. Here, a description is given by taking, as an example, a case in which the document image stored in the RAM 103 is transmitted by fax with reference to the flowchart shown in Fig. 15.

Initially, the user performs a setting for fax transmission in the operation section 105 of the MFP (S1501).

In a touch panel (not shown) provided in the operation section, identification information of the document stored in the RAM 103 is displayed. It is possible for the user to select the document to be transmitted from the displayed identification information. Also, it is assumed that the document image is prestored in the RAM 103 in a tiled state.

After the document to be transmitted is selected, the "resolution" and the "type of document" when the document is to be transmitted are selected. The settings of the fax function in this embodiment are shown in Fig. 16. For the settings of "resolution", there are three selection modes of "standard", "fine", and "superfine", and their specific resolutions are 100 × 100 dpi, 100 × 200 dpi, and 100 × 400 dpi, respectively. Also, for the settings of the "type of document", there are "character" and a "photograph". For specific processing, simple binarization is performed in the case of a "character", and an error diffusion process is performed in the case of a "photograph". The table shown in Fig. 16 is prestored in the ROM 102.

Here, "fine" is selected for "resolution", and "character" is selected for the "type of document". After all the settings related to the fax transmission are completed, the user issues a transmission command by depressing a start button (not shown) (S1502).

When the CPU 101 receives the settings in the operation

section 105 and the transmission command, the CPU 101 reads
corresponding setting values from the table shown in Fig. 16,
which is prestored in the ROM 102. Then, the CPU 101
creates a header in which the identification information and
5 the image processing mode of the IP function section used
for image processing are described in sequence. Furthermore,
the CPU 101 reads the tiled image data corresponding to the
document to be transmitted from the RAM 103 and adds the
created header to the read tiled image data, thereby
10 creating packet data (S1503).

The form of the created packet data is shown in Fig. 17.
As shown in Fig. 16, the "fine mode" regarding the
"resolution" corresponds to the process of mode 1 in the
resolution conversion function section 203, and the
15 "character" regarding the "type of resolution" corresponds
to the process of mode 0 in the binarization function
section 204. Furthermore, in a case where fax transmission
is performed, after image processing is performed, since the
data is stored once in the RAM 103, the processing sequence
20 is resolution conversion function section 203 →
binarization function section 204 → RAM 103. The created
packet data is input to the crossbar switch 201, and the
crossbar switch 201 transfers the packet data to the
resolution conversion function section 203 which is a first
25 IP function section.

The resolution conversion function section 203 inputs the transferred packet data, and the input I/F section 901 divides the packet data to a header and tiled image data, and transfers the header to the header analysis section 902 and transfers the tiled image data to the resolution conversion processing section 903. The header analysis section 902 analyzes the first header part of Fig. 17 at the beginning of the header, and issues instructions to the resolution conversion processing section 903 so that the process of mode 1 is performed. The resolution conversion processing section 903 performs resolution conversion in mode 1 corresponding to the "fine mode" (100 × 200 dpi) on the input tiled image data (S1504). Based on the converted tiled image data, together with the header rewritten by the data selection section 905, packet data shown in Fig. 18 is created, and the packet data is transmitted to the binarization function section 204, which is the next IP function section, by the output I/F section 906.

Similarly, in the rotation function section 205, based on the information of the first header part at the beginning of the header shown in Fig. 18, a process of mode 0 corresponding to "character" (simple binarization) is performed, and new packet data shown in Fig. 19 is created (S1505).

The created packet data is output from the image

processing section 104 via the crossbar switch 201 and is temporarily stored as tiled image data in the RAM 103 (S1506).

The tiled image data which is stored once in the RAM 103 is transferred in a fax transmittable document form to the fax section 110. The fax section 110 performs encoding, such as MMR (Modified Modified Read), on the transferred image data, and after the image data is modulated by a modem, it is transmitted to the other party via a communication line, and the series of processing is terminated (S1507).

Although in this embodiment, only the operations in fax transmission were described, even when, for example, operations, such as electronic sort, PDL (Page Description Language) print, and color copying, are performed, image processing by packet data can be described by the same construction and procedure.

Next, as an example of a concurrent multifunction operation in this embodiment, a description is given of a case in which fax transmission, and a copying operation using electronic sort are performed in parallel.

Here, the electronic sort function is described briefly. In a case where a plurality of copies of the document is made, the printer section of the MFP prevents mixing of copies by causing each copy to be assigned to a plurality of bins provided therein and by performing paper ejection,

which is performed conventionally. In contrast, recently, a digital copier has been proposed in which sheets of paper are output by changing their direction of paper ejection for each copy with respect to one bin. This digital copier

5 changes the direction of the image by performing a rotation process on the input image data within the device, and the printer section forms an image on the basis of the image data in which the direction of the image is changed, thereby changing the ejection direction of the output paper. In the

10 MFP of this embodiment, the image processing section 104 is provided with the rotation function section 205. Therefore, in the MFP of the embodiment, while the CPU 101 controls the operation of the scanner section 106 and the printer section 109, image processing using the rotation function section

15 205 is performed, making it possible to perform this electronic sort function.

The flow of the image data in a case where electronic sort is performed by the MFP of this embodiment is described below. First, the reading of the document by the scanner

20 section 106 is performed similarly to the operation from steps S402 to S404 in the flowchart in Fig. 4, and the tiled image data is stored once in the RAM 103. Here, if the number of documents is large and all the tiled image data cannot be stored in the RAM 103, the data may be stored in a

25 HDD (not shown) as required.

The CPU 101 adds a header, in which processing information of 90° rotation and processing sequence information so as for the data to be returned to the RAM 103 again are described, to the tiled image data which is stored once in the RAM 103 in order to create packet data. The created packet data is then transferred to the image processing section 104, and the packet data which is rotated by 90° by the rotation function section 205 is stored again as the tiled image data in the RAM 103.

The CPU 101 transfers the tiled image data stored in the RAM 103 to the printer I/F section 108, and the printer I/F section 108 reconstructs the tiled image data into image data in page units. The created image data in page units is sent to the printer section 109, and the printer section 109 forms an image on output paper on the basis of the transferred image data, and the output paper on which an image is formed is output to a paper-ejection tray. The above process is repeated until a specified number of copies of image output is completed. At this time, by changing the angle of rotation in units of copies, electronic sort is realized.

In the foregoing, the operation in a case where electronic sort of the MFP according to this embodiment was described. It is assumed that, while a copying operation using this electronic sort function is being performed, the

operator instructs a fax operation shown in Fig. 13. Then,
the CPU 101 starts the fax operation according to the
instructions, and the MFP enters a state of a concurrent
multifunction operation in which a fax operation and a
5 copying operation using the electronic sort function are
performed concurrently. At this time, the image processing
section 104 is in a state in which the resolution conversion
function section 203 and the binarization function section
204 are used for the fax operation, and the rotation
10 function section 205 is used for the copying operation
(electronic sort). Therefore, in the image processing
section 104, image data to be processed in the fax operation,
and image data to be processed in the copying operation
coexist.

15 However, as has thus been described, even when a large
number of image processing is performed concurrently, the
CPU 101 needs only to perform a process for creating packet
data and transferring the packet data to the first IP
function section, and does not need to perform status
20 management related to each IP function and timing control
related to image data. Therefore, it is possible to perform
a concurrent operation without imposing a large load on the
CPU 101.

25 In addition, by performing processing in tile units,
there is no need to provide an image processing section for

each operation and memory in page units, and efficient image processing can be performed.

In this example, a concurrent multifunction operations of a fax function and an electronic sort function were

5 described. As a concurrent operation, the same description can be made even for a case of a fax operation and a PDL print, and a case of electronic sort and a PDL print.

Furthermore, the concurrent multifunction operation is not limited to two functions, and, for example, a concurrent
10 multifunction operation of three functions, such as a fax operation, electronic sort, and a PDL print, may be performed.

As has thus been described, according to this embodiment, a header in which image processing sequence
15 information, processing content information, etc., are described is added to tiled image data so as to create packet data, and the created packet data is transferred among IP function sections. Furthermore, within each IP function section, packet data is input, and image processing
20 of the tiled image data is performed in accordance with the processing content information described in the header, and packet data to which the header, in which the image processing sequence information and the processing content information are rewritten, is added to the tiled image data
25 after processing and is output.

As a result, advantages can be obtained in that the management of each IP function section in a series of image processing operations performed by the CPU can be facilitated, and the load of the management of the image processing section in the control of the entire system can be reduced.

According to this embodiment, when a copying operation using an electronic sort function and a fax transmission operation are performed in parallel, packet data corresponding to the copying operation is created by using tiled image data for the copying operation, and packet data corresponding to the fax operation is created by using tiled image data for the fax operation, so that the packet data for the copying operation and the packet data for the fax transmission operation coexist in the image processing section. Then, in the image processing section, while processing of the packet data for the copying operation is being performed by an IP function section, in another IP function section, processing of the packet data for the fax operation is performed.

As a result, even in a state in which a concurrent multifunction operation is performed, the CPU needs only to create packet data corresponding to the respective operations, yielding the advantage that image processing can be performed efficiently without imposing a large load on

the CPU. Furthermore, since processing in units of tiled image data becomes possible, it is not necessary to allocate a memory and an image processing section in page units, yielding the advantage that efficient image processing can be performed.

In addition, image processing information in the header of the packet data in this embodiment is described in sequence from the beginning of the header in accordance with the sequence in which image processing is performed. Then, in the IP function section, after image processing is performed, a first header part is deleted, and the header part is shifted forward in sequence to the previous header part. As a result, the header analysis section in each IP section needs only to analyze only the information at the beginning of the packet data, yielding the advantage that common design of the construction in each IP function section is made possible.

Many different embodiments of the present invention may be constructed without departing from the spirit and scope of the present invention. It should be understood that the present invention is not limited to the specific embodiments described in this specification. To the contrary, the present invention is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the invention as hereafter claimed. The scope of

the following claims is to be accorded the broadest interpretation so as to encompass all such modifications, equivalent structures and functions.

1. A method of determining the relative positions of a plurality of points in a two-dimensional space, comprising the steps of: (a) selecting a first point as a reference point; (b) measuring the distance from the reference point to each of the other points; (c) determining the relative positions of the other points based on the measured distances.